

APPLICATION FOR UNITED STATES LETTERS PATENT

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INVENTION: DATA PROCESSING APPARATUS,
 DATA PROCESSING METHOD,
 PROGRAM, AND
 INK JET PRINTING SYSTEM

S P E C I F I C A T I O N

This application claims priority from Japanese Patent Application No. 2002-247691 filed August 27, 2002, which is incorporated hereinto by reference.

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BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a method, an
10 apparatus, a program to process data to be sent to a
printing apparatus capable of executing a marginless
printing that leaves no blank margins at edges of a
print medium, and a printing system including the data
processing apparatus and the printing apparatus.

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DESCRIPTION OF THE RELATED ART

Among modes in which an ink jet printing
apparatus prints on a print medium, a so-called
20 marginless printing is known, which forms an image on
an entire surface of the print medium without leaving
any blank margins at peripheries of the print medium.
With this marginless printing, a printing operation is
performed until there is no blank margin left at at
25 least one of top, bottom, left and right edges of the
print medium. To ensure that peripheral parts of the
print medium are printed reliably, the printing

apparatus ejects ink not only over a print area inside the edges of the print medium but also over an area extending a few millimeters outwardly beyond the edges. Ink that is applied to the outside of the print medium
5 lands on an ink absorbing member on a platen (platen absorbent) and is absorbed in it.

In this printing apparatus, until the amount of ink accumulated in the platen absorbent exceeds a predetermined volume, a problem of contaminated print
10 medium and apparatus scarcely occurs. But once a total volume of accumulated waste ink exceeds an absorption limit of the platen absorbent, the ink oozes out from this absorbent, staining a back of the print medium or, in some cases, adhering to an interior of an ink jet
15 printing apparatus. To deal with this problem, this kind of ink jet printing apparatus cumulatively adds up the volume of waste ink applied to the platen absorbent and, when the sum reaches the absorption limit of the platen absorbent, displays an error
20 prompting a replacement of the platen absorber.

The management of the waste ink volume and the error annunciation described above may be carried out as follows. (A) The printing apparatus may perform the steps of (1) analyzing print data received from a host
25 to calculate the waste ink volume applied during the marginless printing, (2) cumulatively adding a value representing the calculated waste ink volume to a

value representing a total volume of waste ink accumulated in the platen absorbent up to that point in time (platen waste ink volume) and (3) when the cumulative value exceeds a predetermined value (e.g., absorption limit), issuing an alarm signal, such as an annunciation that "ink may ooze out of a platen absorbent." (B) The host may perform the step of (4) displaying an error based on the alarm signal received from the printing apparatus.

10 With the method described above, however, since the printing apparatus must perform data processing, such as analyzing the print data sent from the host to calculate the waste ink volume applied during the marginless printing and cumulatively adding the
15 calculated waste ink volume, the processing load of the printing apparatus increases, complicating the control. Another problem is that the load of this additional data processing affects other processing (e.g., indexing the received print data), reducing the
20 processing speed of the apparatus as a whole and therefore the printing operation speed. Further, to store a program for executing the data processing described above requires installing a memory of large capacity (ROM) on the printing apparatus side, and
25 such a large-capacity memory is costly. In addition, for the above data processing to be executed, a high-performance calculation means (CPU) is required. Such

a high-performance calculation means is also costly.
These processing therefore results in a cost increase.

SUMMARY OF THE INVENTION

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The present invention has been accomplished to overcome the aforementioned problems experienced with the conventional techniques and provides a data processing method, a data processing apparatus and a printing system including the data processing apparatus and a printing apparatus, which enable a marginless printing with no ink overflow related problem, without providing a large-capacity memory or a high-performance calculation means in the printing apparatus or without reducing a printing speed as practically as possible.

To achieve the above objective, the present invention has the following construction.

Viewed from one aspect, the present invention provides a data processing method for processing data to be supplied to an ink jet printing apparatus, wherein the ink jet printing apparatus can perform a marginless printing that forms an image on a print medium up to the very edges of the print medium by, according to print data, ejecting ink onto an area inside the edges of the print medium and onto an overrunning area outside the edges, the data

processing method comprising: a waste ink volume
determining step to determine a value equivalent to a
waste ink volume associated with the marginless
printing; and a data sending step to send to the ink
5 jet printing apparatus data representing the value
equivalent to a waste ink volume determined by the
waste ink volume determining step.

In a second aspect, the present invention
provides a data processing apparatus for supplying
10 data to an ink jet printing apparatus, wherein the ink
jet printing apparatus can perform a marginless
printing that forms an image on a print medium up to
the very edges of the print medium by, according to
print data, ejecting ink onto an area inside the edges
15 of the print medium and onto an overrunning area
outside the edges, the data processing apparatus
comprising: a waste ink volume determining means to
determine a value equivalent to a waste ink volume
associated with the marginless printing; and a data
20 sending means to send to the ink jet printing
apparatus data representing the value equivalent to a
waste ink volume determined by the waste ink volume
determining means.

In a third aspect, the present invention provides
25 a program for controlling an ink jet printing
apparatus, wherein the ink jet printing apparatus can
perform a marginless printing that forms an image on a

print medium up to the very edges of the print medium
by, according to print data, ejecting ink over a range
from an area inside the edges of the print medium to
an overrunning area outside the edges, the program
5 causing a computer to execute a waste ink volume
determining step to determine a value equivalent to a
waste ink volume associated with the marginless
printing; and a data sending step to send to the ink
jet printing apparatus data representing the value
10 equivalent to a waste ink volume determined by the
waste ink volume determining step.

In a fourth aspect, the present invention
provides an ink jet printing system having an ink jet
printing apparatus and a host for supplying print data
15 to the ink jet printing apparatus, wherein the ink jet
printing apparatus can perform a marginless printing
that forms an image on a print medium up to the very
edges of the print medium by, according to print data,
ejecting ink over a range from an area inside the
20 edges of the print medium to an overrunning area
outside the edges, (A) the host comprising: a waste
ink volume determining means for determining a value
equivalent to a waste ink volume associated with the
marginless printing; and a data sending means for
25 sending to the ink jet printing apparatus data
representing the value equivalent to a waste ink
volume determined by the waste ink volume determining

means; (B) the ink jet printing apparatus comprising:
an ink receiving member for receiving waste ink
ejected onto the overrunning area outside the edges of
the print medium during the marginless printing; and
5 an accumulated value memory means for cumulatively
adding up data representing the values equivalent to
waste ink volumes sent from the host and storing an
accumulated value equivalent to waste ink volumes
ejected onto the ink receiving member during the
10 marginless printing.

With this invention of the above construction,
complex data processing such as determining a value
equivalent to a waste ink volume is performed by the
host, so that the ink jet printing apparatus needs
15 only to perform very simple processing such as adding
up or storing data processed by the host (data
representing a waste ink volume). This eliminates the
need for a high-performance calculation/storing means
and a large-capacity memory, and enables the system to
20 be constructed at a reduced cost. This arrangement
also enables a high-speed printing even during a
marginless printing.

Further, since, with this invention, the
processing to determine a value equivalent to a waste
25 ink volume associate with each marginless printing is
performed by the host and the value equivalent to a
waste ink volume determined by the host is sent to the

ink jet printing apparatus which then stores the received value, the processing load on the ink jet printing apparatus can be reduced significantly. Further, this configuration obviates the need for
5 installing a large-capacity memory and a high-performance calculation means and thus can reduce the cost. Further, since the host executes the waste ink volume determining processing while at the same time performing image processing, the ink jet printing
10 apparatus can omit the processing of reanalyzing print data, simplifying the control system of the printing apparatus as a whole.

The above and other objects, effects, features and advantages of the present invention will become
15 more apparent from the following description of embodiments thereof taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

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Fig. 1 is a perspective view showing an outline configuration of an ink jet printing apparatus applied to one embodiment of the present invention;

Fig. 2 is a schematic diagram showing an area
25 outside a print medium to which ink is applied during a marginless printing in one embodiment of the invention;

Fig. 3 is an explanatory diagram conceptually showing a sequence of processing performed by a printer driver on a host in one embodiment of the invention;

5 Fig. 4 is a flow chart showing a control operation performed by the host to count ink dots ejected outside the print medium in one embodiment of the invention;

10 Fig. 5 is a block diagram schematically showing a control system of an ink jet printing apparatus in one embodiment of the invention;

15 Fig. 6 is a flow chart showing a control operation to set a platen waste ink volume in the ink jet printing apparatus in one embodiment of the invention; and

 Fig. 7 is a flow chart showing a control operation executed according to an accumulated volume of platen waste ink in one embodiment of the invention.

20 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

 Now, one embodiment of the present invention will be described by referring to the accompanying drawings.

25 Fig. 1 is a perspective view showing an outline construction of an ink jet printing apparatus that can apply the present invention. In the figure, a print medium P inserted into a paper feed port 100a of the

printing apparatus 100 is fed in a direction of arrow Y by a feed roller 106 to a printing area where it is printed by a head cartridge 104. In the printing area there is a flat platelike platen 107 on which the
5 print medium P is supported in a horizontal, planar state. The platen 107 has a platen absorbent (ink receiving member), which receives and absorbs ink applied outside the print medium P. The platen absorbent of this embodiment is made so that if waste
10 ink ejected onto the platen absorbent is less than its maximum ink absorption volume (absorption limit), the waste ink will not adhere to the back of the print medium P as it slides over the platen. The platen absorbent has a width in excess of a maximum width of
15 the print medium P as measured in the main scan direction, wide enough to tolerate insertion errors and transport errors of the print medium P.

A carriage 101 is axially movable along two guide shafts 102, 103 and driven by a carriage motor not
20 shown to reciprocally scan in the main scan direction (indicated by arrows X1, X2). After each main scan by the carriage 101, the print medium P is fed a predetermined distance (equivalent to a print width of a print head 104) in a subscan direction (indicated by
25 arrow Y) for the next main scan operation. These main scan and subscan operations are repeated until one page printing is completed.

The head cartridge 104 mounted on the carriage 101 has a print head with an array of ink ejection nozzles arranged at a predetermined density and an ink tank to supply ink to the print head. A face of the print head formed with nozzle openings opposes the print medium P transported onto the platen 107. Denoted 108 is an operation unit having switches and indicators, with switches used to turn on or off power of the ink jet printing apparatus 100 and set a variety of printing modes and with the indicators displaying a state of the ink jet printing apparatus 100 in the event of errors.

Fig. 2 schematically shows an area E1 overrunning the print medium P where ink is also applied. As shown in the figure, the ink jet printing apparatus 100 ejects ink dots (waste ink dots) not only inside but also outside the top and bottom edges and left and right edges of the print medium P during the marginless printing. In this embodiment, the volume of waste ink applied to the overrunning area E1 (hereafter referred to as a platen waste ink volume) is determined by a printer driver described later.

Fig. 3 conceptually illustrates a procedure of operation performed by a printer driver used in a host 200 connected to the ink jet printing apparatus of Fig. 1.

In a normal printing, when the user specifies

printing, the host 200 performs separation processing (202) to separate image data 201 into print data of four colors (cyan (C), magenta (M), yellow (Y), black (K)) (in the case of color print data) or black (K) print data (in the case of monochromatic print data).
5 Next, rasterize processing (203) is executed to separate print data of each color into 1-raster data. Then, the rasterized data is sent to an output module 300 where it is subjected to vertical-horizontal
10 conversion and data compression (301). The vertical-horizontal conversion means processing to convert a data arrangement from raster data (horizontally arranged data) into column data (vertically arranged data).

15 When raster data for one scan is accumulated in the output module 300, a printing apparatus operation command is attached to the raster data which is then transferred to a sending buffer 204. The sending buffer 204, after a predetermined volume of data is
20 accumulated, sends it to the ink jet printing apparatus 100.

When the user specifies a marginless printing, the printer driver in the host 200 checks if there is any print data that causes ink to be ejected onto the
25 overrunning area E1 outside the print medium P. If such print data exists, a waste ink volume determination means 302 in the output module 300

counts the number of ink dots for each color that are ejected outside the print medium P. After the printing operation for one page is finished, the dot count value for one page is sent from the output module 300 to the sending buffer (sending means) 204, from which it is further transmitted to the ink jet printing apparatus 100.

Now, the processing of counting the number of ink dots to be ejected outside the print medium, as performed by the output module 300 when the marginless printing is specified, will be explained by referring to the flow chart of Fig. 4.

First, at the head of the print data of one page, a dot counter for counting the number of ink dots to be ejected outside the print medium P is initialized (cleared to zero) (step S41). Next, raster data is retrieved (step S42) and a check is made to see if the data retrieved is the one for ink dots to be ejected outside the print medium (step S43). If it is decided that the retrieved raster data is outside the print medium P, the number of dot data is counted and added to a cumulative count value (step S44).

After this, it is checked whether the count operation described above has been done for one page of print data. If it is decided that the count operation is finished for one page (step S45), the data for that page representing the count value of ink

dots to be ejected outside the print medium P (waste ink dot number) is transmitted to the ink jet printing apparatus (step S46). If there is a next page to be printed (step S47), the processing is repeated

5 beginning with step S41.

Now, an outline configuration of a main portion of the control system of the ink jet printing apparatus 100 as applied to this embodiment of the invention will be explained by referring to a block
10 diagram of Fig. 5. The control system of the ink jet printing apparatus 100 receives from the host 200 character and image data to be printed and temporarily stores it in a receiving buffer 401. Data representing an operation state of the printing apparatus 100 that
15 was output from a CPU 402 is also transferred through the receiving buffer 401 to the host 200.

The data from the host 200 accumulated in the receiving buffer 401 is processed under the control of the CPU 402 to produce data that can be printed by the
20 print head as it performs the main scan, and the processed data is stored in a random access memory (RAM) 403. The data in the RAM 403 is transferred by a print head control unit to a print head 408 which, according to the received data, drives an ejection
25 energy generation means such as electrothermal transducers in the head to eject ink droplets, thus forming characters and images. A mechanism unit 406

controls the operations of carriage motor and line feed motor not shown. A display unit 407 comprises display panels, such as LEDs and liquid crystal display elements driven by commands from the CPU 402,
5 and a control unit for controlling them.

The host 200, as described above, sends not only the print data for causing ink dots to be ejected onto the print medium but also the count value of ink dots to be ejected outside the print medium (waste ink dot
10 number). The data representing the waste ink dot number is stored in the receiving buffer 401. When this waste ink dot number data is received from the host 200, the CPU 402 retrieves from a programmable nonvolatile memory (accumulated value memory means)
15 405 such as EEPROM an accumulated number of ink dots ejected onto the overrunning area E1 outside the print medium P, adds up the accumulated value and the dot count number stored in the receiving buffer 401, and stores the latest accumulated value of the platen
20 waste ink volume in the EEPROM 405.

A control operation performed by the ink jet printing apparatus when it receives data representing the waste ink dot number from the host 200 will be explained by referring to a flow chart of Fig. 6.

25 First, when the receiving buffer 401 receives data representing the waste ink dot number (step S61), a check is made to see if the value is not zero (step

S62). Next, if the value is determined to be not zero, the platen waste ink volume to be ejected onto the platen absorbent is determined based on the waste ink dot number (step S63). Then, the accumulated platen waste ink volume up to the previous marginless printing operation is read from the EEPROM 405 (step S64), and the platen waste ink volume to be ejected by the current marginless printing operation is added to the accumulated platen waste ink volume (step S65).
10 Then, the newly obtained accumulated platen waste ink volume is stored in (written into) the EEPROM 405 (step S66). While the flow chart of Fig. 6 manages the waste ink volume by using the waste ink volume itself, it may of course be managed by using the number of ink dot number. In that case, the waste ink volume does not have to be calculated from the data representing the waste ink dot number, and the dot number information is stored in the EEPROM 405.

Fig. 7 is a flow chart showing a control operation executed by step S66 of Fig. 6 according to the "accumulated platen waste ink volume" stored in the EEPROM 405.

Each time step S66 of Fig. 6 stores the new accumulated platen waste ink volume in the EEPROM 405, the CPU 402 checks whether the stored accumulated platen waste ink volume has reached (or exceeded) a predetermined value (step S71, S72). Here, the

predetermined value is a maximum ink absorption volume (absorption limit) of the platen absorbent or a slightly smaller value. When the accumulated platen waste ink volume is found to have reached (or
5 exceeded) the predetermined value, an indication element (such as LED) of the display unit 407 is turned on, indicating that the waste ink has reached (or exceeded) the maximum ink absorption volume of the platen absorbent or is about to reach it. At the same
10 time, warning data is sent to the host 200 (S74). Upon receiving this warning data, the host 200 displays an error dialog on a screen, alerting the user to the fact that the platen absorbent is full of waste ink or nearly full. In this error state, it may be an
15 effective step to disable the operation of the ink jet printing apparatus.

The check on the accumulated platen waste ink volume may be performed when the power of the ink jet printing apparatus is turned on or after a printed
20 medium is discharged.

With the above embodiment, in the process of marginless printing, complex processing such as extracting data of platen waste ink dots from print data and determining the number of the waste ink dots
25 is carried out by the host 200 and the ink jet printing apparatus 100 need only sum up the platen waste ink dot numbers sent from the host 200. This

simplifies the control executed on the part of the ink jet printing apparatus 100 to a large extent and obviates the need for a large-capacity memory (e.g., ROM) and a high-performance calculation device (e.g., CPU), resulting in a cost reduction. This arrangement also reduces the processing time taken by the ink jet printing apparatus, preventing a possible reduction in the printing speed of the ink jet printing apparatus.

Further, in the above embodiment, since a warning is issued to the user when the ink volume absorbed in the platen absorbent reaches a predetermined value, it is possible to prevent a print medium from being stained on its back as it passes over the platen absorbent that no longer can absorb ink or to prevent an interior of the ink jet printing apparatus from being contaminated by ink from the platen absorbent.

Further, in the above embodiment, in determining on the part of the host the waste ink volume applied during the marginless printing, since the number of ink dots ejected onto the overrunning area outside a print medium is counted, it is possible to obtain highly precise information on the waste ink volume in units of dot.

While in the above embodiment the information on the waste ink volume is obtained by the dot counting and then transmitted to the printing apparatus, the present invention is not limited to this configuration.

For example, a value representing a predetermined waste ink volume that matches a print medium size may be selected and sent to the printing apparatus.

That is, the processing of counting dots ejected
5 onto the overrunning area is not performed but a particular value corresponding to the print medium size is determined to be a "value equivalent to the waste ink volume". Since the dot counting is not executed, the precise number of ink dots to be ejected
10 onto the overrunning area outside the print medium is not known and therefore this configuration is not as good as the above embodiment in terms of accurately managing the waste ink volume. It has, however, an advantage of simplified processing because the dot
15 counting is not performed. In this configuration, different values are used as the waste ink volume for different sizes of print media, while the same value is used for print media of the same size without regard to a print duty.

20 As can be seen from the above, it is important for the host to obtain a value equivalent to the waste ink volume applied during the marginless printing. The method of obtaining this value is not limited to the dot counting.

25 In the above embodiment, although whether or not the accumulated waste ink volume has reached a predetermined value is checked on the ink jet printing

apparatus side, this check can be done on the host side. This can alleviate the burden on the ink jet printing apparatus. It is noted, however, that in this case too, at least an accumulated value memory means
5 (e.g., ROM) to store a latest accumulated value of the waste ink volume is required, and that when the power of the ink jet printing apparatus is turned on, the accumulated value read from the accumulated value memory means needs to be transmitted to the host. The
10 host then adds up the accumulated value sent from the ink jet printing apparatus and the number of waste ink dots extracted from the print data and sends the sum as a latest accumulated value to the ink jet printing apparatus where it is stored in (written into) the
15 accumulated value memory means.

Further, ink jet printing apparatus commonly perform a preliminary ink ejection operation and a recovery operation by suction to discharge bubbles and viscous ink from a print head. Waste ink ejected or
20 sucked out from the print head during this recovery operation is accommodated in an ink absorbent. In the above embodiment, a situation is contemplated in which the waste ink absorbent to absorb ink discharged during the recovery operation is separately provided
25 in addition to the platen absorbent (waste ink receiver). Therefore, a warning is issued based on only the waste ink volume applied during the

marginless printing. In some ink jet printing apparatus, however, the waste ink absorbent for the recovery operation and the platen absorbent are formed integral or connected together. In that case, the ink
5 absorbing state of the waste ink absorbent needs to be detected by also considering the waste ink volume from the recovery operation.

The present invention has been described in detail with respect to preferred embodiments, and it
10 will now be apparent from the foregoing to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and it is the intention, therefore, in the appended claims to cover all such changes and
15 modifications as fall within the true spirit of the invention.